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Indian Standard

METHOD OF PHOTOMETRIC TESTING OF INCANDESCENT TYPE LUMINAIRES FOR GENERAL LIGHTING SERVICE

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METHOD OF PHOTOMETRIC TESTING OF INCANDESCENT TYPE LUMINAIRES FOR GENERAL LIGHTING SERVICE

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0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 14 April 1975, after the draft finalized by the Illuminating Engineering Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 With a view to bringing about uniformity in testing procedure so that results will be comparable from the various laboratories, this standard on the method for the photometric testing of luminaires for general lighting service has been prepared. It is applicable to complete filament type general lighting luminaires falling within the following luminaire classifications*:

a) Direct,
b) Semi-direct,
c) General diffuse,
d) Semi-indirect, and
e) Indirect.

0.3 This standard does not at present cover luminaires with internal mirrored lamps. The procedure for photometric testing for such luminaires is under consideration and will be added later.

0.4 In preparing this standard, assistance has been derived from 'IES Approved method for the photometric testing of incandescent type luminaires for general lighting service, 1970' published by the Illuminating Engineering Society, USA.

0.5 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960†.

*Based on the classification approved by the International Commission on Illumination (CIE).

†Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers the method for photometric testing of filament type general lighting luminaires of the following classifications:

a) Direct,

b) Semi-direct,

c) General diffuse,

d) Semi-indirect, and

e) Indirect.

NOTE — Suitable illustration will be added later.

1.2 This standard does not cover method for photometric testing for special purpose luminaires. In such cases this method may be followed in principle, if not in detail, including tests on luminaires employing linear sources, nonsymmetrical louvres, etc.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 1885 (Part XVI/Sec 1)-1968* and the following shall apply.

2.1.1 *Rated Lumen Output* — Luminous flux marked on the lamp or declared as such.

2.1.2 *Designed Lumen Output* — Nominal luminous flux for which the lamp is designed.

3. SELECTION OF LUMINAIRES FOR TEST

3.1 The units should be representative of a manufacturer's regular product. However, methods for selection and tests of special types of luminaires for general lighting service are given in Appendix A.

4. TEST APPARATUS

4.1 General — It is not intended to describe the complete photometric and control equipment but only those characteristics which will ensure useful and reliable test results, are covered.

4.2 Electrical Supply and Instruments — All photometric measurements are dependent upon the performance of electrical instruments and the stability of the power supply. The supply voltage shall be stabilized within $\pm 0{\cdot}5$ percent, and if not, the operating voltage fluctuation shall be stated. The voltmeters, ammeters and wattmeters to be used in tests shall satisfy the requirements of IS : 6236-1971†.

*Electrotechnical vocabulary: Part XVI Lighting, Section 1 General aspects.
†Specification for direct recording electrical measuring instruments.

4.3 Test Lamp — The size, finish, filament construction of the test lamp should be that recommended by the luminaire manufacturer. The test lamp should be aged for 10 percent of the specified lamp life at rated voltage to ensure stability of the output. As a word of caution it should be noted that lamps of different types of filament construction will not necessarily produce distribution curves of the same shape or efficiency especially in reflector type of luminaires.

5. TEST PROCEDURE

5.1 Inspection and Preparation of Luminaire for Test — If a luminaire reaches the laboratory with signs of damage in transit which might affect the lighting performance in any way, it can no longer be considered a representative test specimen and should not be tested as such.

5.2 Cleaning of Optical Parts — All light controlling parts of the luminaire should be thoroughly cleaned before testing unless otherwise specifically stated for any particular test like decrease of light output due to dirt accumulation.

5.3 Mounting of Luminaire on Distribution Photometer

5.3.1 The lamp and luminaire should be mounted so that they are concentric with the filament in the specified location. They should also be concentric with the axis of rotation if they are to be rotated during the test.

5.3.2 The alignment of the luminaire is dependent on the type being tested. For semi-direct, general diffuse and semi-indirect units, the centre of the lamp filament shall coincide with the intersection of the two axes of rotation. For direct and indirect luminaires, the plane of the opening of aperture should be placed on the axis. In cases of asymmetrical luminaires, such as angle reflectors, the lamp axis should be aligned with the photometer axis and the luminaire should be mounted and aligned in such a way that the proper optical axis coincides with the photometric axis.

5.3.3 Suspended luminaires should be tested with the type of hanger usually supplied, where the hanger can affect photometric performance. The hanger should be reinforced, if necessary, to insure a rigid concentric support. Any departure from mechanical symmetry or concentricity in production should be recorded.

5.4 Luminous Intensity Distribution Measurements

5.4.1 With the test luminaire operating at a constant specified voltage, measurements of luminous intensity are made at 0° (nadir), 90° and 180° from nadir and at intervals of 10° starting at 5° and ending at 175°. When necessary readings may be taken at closer intervals if measurements vary rapidly or in case of concentrating distributions.

5.4.2 *Photometry of Symmetrical Luminaires* — Two methods may be adopted to make photometric measurements of luminaires. In one case, which is easily applicable in the case of symmetrical luminaires, the bare lamp and luminaire may be rotated, say, at approximately 50 revolutions per minute. In the other case when the luminaire cannot be rotated, photometric readings should be taken through sufficient vertical planes to determine luminaire distribution. With a symmetrical luminaire, it is usually sufficient to measure in four planes equally spaced around the luminaire (that is, eight vertical distribution curves from nadir to 180° and one of the half-planes passing through the filament gap). Rotation of the lamp in a stationary luminaire is recommended, since it minimizes the results of unevenness in lamp distribution. However, if the luminaire and lamp are not rotated, the position of the filament with respect to luminaire orientation should be recorded.

5.4.3 *Photometry of Asymmetrical Luminaires* — In the case of asymmetrical luminaires or those with lamps of nonsymmetrical light distribution, the planes of measurement should be equally spaced at 10° intervals about the luminaire axis. The planes should be identified with respect to some describable plane of reference through lamp and luminaire.

5.4.4 For asymmetrical luminaires, or those equipped with lamps of nonsymmetrical output (such as monoplane-filament lamps), where luminaire or lamp rotation or both would be of no value, the planes of measurement should be equally spaced at 10°-intervals about the luminaire axis. These planes should be labelled or identified with respect to some describable plane of reference through lamp and luminaire.

In some cases it may be advisable to make distributions in cones (lateral distribution) about the luminaire at 5°, 15°, etc, to 90°.

NOTE — The integrating sphere of suitable size may also be used for determining luminaire efficiencies of asymmetrical luminaires.

5.5 Measurement of Luminance

5.5.1 Luminance should be measured at viewing angles of 45°, 55°, 65°, 75° and 85°.

5.5.2 The readings should represent the highest luminance of any 2·5 cm^2 area visible in the indicated direction which usually but not necessarily includes the brightest spot visible.

6. TEST REPORT

6.1 General — The test report should describe the data given in **5.2**, **5.3** and **5.4** concerning the luminaire tested. A typical test report is shown in Fig. 2. The data should be listed in a manner that will allow derivation of the maximum amount of information. (*see also* Tables 1 and 2).

TABLE 1 TYPICAL EXAMPLE OF LUMINAIRE DISTRIBUTION DATA

Mean Vertical

Mid Zone Angles	Zonal Lumens	Mid Zone Angles	Zonal Lumens
(1)	(2)	(1)	(2)
90° Hor.	—	37·5°	320
87·5°	9	32·5°	389
82·5°	15	27·5°	552
77·5°	35	22·5°	604
72·5°	54	17·5°	477
67·5°	70	12·5°	340
62·5°	84	7·5°	210
57·5°	107	2·5°	72
52·5°	128	0° Nad.	
47·5°	168		
42·5°	231		

TABLE 2 TYPICAL EXAMPLE OF LIGHT FLUX VALUES

Zone	Lumens of Luminaire	Percent
(1)	(2)	(3)
0° – 30°	2 255	38·0
0° – 40°	2 964	50·0
0° – 60°	3 598	60·5
0° – 90°	3 865	65·0
90° – 180°	—	—
0° – 180°	—	—

Note — For luminaire luminance, *see* Fig. 2.

6.2 Luminaire Description — The luminaire description shall include:

a) manufacturer's name,

b) luminaire type and catalogue numbers, and

c) classification of luminaire (measurement and reporting of reflectance and transmittance is optional).

6.2.1 There should be a drawing showing the following:

a) Shape and essential dimensions of luminaire,
b) Light centre position,
c) Base contact position of lamp, and
d) Shielding or cut off angles and angle below horizontal at which lamp neck is not visible in luminaires having an upward lighting component.

6.3 Test Lamp Description — The lamp description should include the following:

a) Watts,
b) Volts,
c) Cap,
d) Size,
e) Colour and finish of lamp bulb,
f) Filament dimensional drawing,
g) Lumen output, and
h) Light centre length.

6.4 Photometric Data — Photometric data should be based on the rated lumen output of the lamp for absolute photometry and on the designed lumen output of the lamp for relative photometry. In tables of coefficients of utilization, the lumen value on which it is based should appear in the heading to the table.

6.4.1 There should be a graph of luminous intensity from nadir to 180°, representing average distribution if the luminaire is rotated. If a number of planes were taken on a stationary symmetrical luminaire an average distribution curve may be plotted, if it is representative enough to provide accurate light output ratio. If the variation between planes is significant, properly labelled curves should be added, illustrating the order of difference between the luminous intensity distributions in different planes.

6.4.1.1 There should be a tabulation of luminous intensity values corresponding to the average distribution (*see* **6.4.1**), including values at nadir, 90° and 180°. Tabulations of luminous intensity on nonsymmetrical luminaires are not usually required as part of the formal test report; however, tabulations of luminous intensity in all of the planes measured should be made available as an addendum to the report.

6.4.2 *Tabulation of Lumen Output Data* (see **6.4**) — Tabulation of lumens and percentages of bare-lamp output for zones 0° to 90°, 90° to 180° and 0° to 180° should be included. The latter value will be the efficiency of the luminaire.

6.4.2.1 Tabulation of whatever significant lumen data may be derived from tests on a nonsymmetrical luminaire should be shown.

6.4.3 *Tabulation of Luminance Readings* — The report should state the size and shape of the area included. The values tabulated will be those obtained under **5.5** and in the table given in **A-3.2.** The drawing of the luminaire (*see* Fig. 1) is a vital part of the report on luminance measurements. If discomfort glare is a consideration, both average and maximum luminance data should be recorded and stated.

6.4.3.1 Luminance values should be reported in cd/cm^2.

APPENDIX A

(*Clause* 3.1)

METHOD FOR SELECTION AND TESTS OF SPECIAL TYPES OF LUMINAIRES

A-1. SPECIAL PROCEDURE FOR THE SELECTION OF DIFFUSING GLOBES

A-1.1 Since diffusing globes may vary in weight and in density of diffusing material, it is customary for several specimens to be submitted to the testing agency. Based on the weight of the individual pieces, samples of average weight should be tested for light output ratio, either in an integrating sphere photometer or by the distribution curve method from which the total luminous flux may be computed. This sample should be the one reported as representing the average luminous intensity distribution of the specimens submitted.

A-2. TEST LAMP

A-2.1 The test lamp should be selected with consideration given to such items as tolerances regarding eccentricity, maximum overall length and light centre length. In the case of clear bulb lamps, the filament dimensions should be measured and recorded.

A-2.2 An optical comparator is suitable for making measurements of filament dimensions.

A-2.3 In the case of diffusing enclosing globes, the test lamp should be of a wattage suitable to the size of the globe. The following are sizes of test

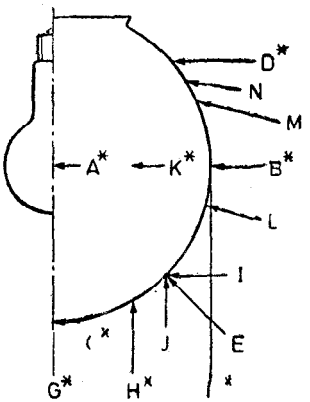
lamps suggested, and these should be used unless the globe manufacturer gives other instructions:

Approximate globe diameter (mm)	200	280	300	350	410	460	510
Lamp wattage (in watts)	60	100	150	200	300	500	1 000

A-3. TEST PROCEDURE

A-3.1 Gallery for Enclosing Type Luminaires — The gallery used during total lumen output and luminous intensity distribution tests should be of the type and style recommended by the manufacturer. If enclosing globes are submitted for test without instructions as to gallery type the top opening should be covered by a disk of matt material of neutral colour having a reflectance of 40 percent. Where no gallery is specified, the distance from the cap contact of the lamp base to the plane of gallery screws should be set in accordance with the following dimensions unless other instructions have been given:

Gallery diameter (mm)	100	100	200	250	300	75*
Cap electrical contact position (mm)	38	50	75	100	100	—



NOTE — The viewing directions shown by dash lines indicate maximum values that are to be searched out. All viewing directions lie in the plane of the paper (a vertical plane through the axis of the globe), except for *A* and *K*, which lie parallel to it.

FIG. 1 DIRECTIONS OF VIEW FOR LUMINANCE MEASUREMENTS

A-3.2 Luminance Measurements — Special instructions for making maximum luminance measurements on diffusing enclosing globes and other filament type luminaires are set forth in the following table and a typical test report is given in Fig. 2.

Luminance Readings on All Filament Type Luminaires (see *Fig.* 1)

(1)

The luminaire is assumed to be in the normal pendant position.

A. Luminance viewed horizontally in line with the light source.

E. Maximum luminance below the maximum diameter viewed at 45° from the nadir.

G. Centre luminance viewed vertically, offset if necessary to avoid an opening, opaque area, etc, in the globe or luminaire.

O. Maximum luminance viewed at 55° from the nadir.

P. Maximum luminance viewed at 65° from the nadir.

Q. Maximum luminance viewed at 75° from the nadir.

R. Maximum luminance of the lamp neck, viewed at 85° from the nadir.

S. Luminance of the uppermost portion of the lamp neck if exposed, as viewed just above the rim of the luminaire. The angle of observation should be reported.

T. Luminance at the angle of cutoff of the lamp neck above maximum dimension of open top or ring type luminaires. The angle of cutoff to be stated in the report.

Luminance Measurements on Diffusing Enclosing Globes (see *Fig.* 1)

(2)

One of the functions of the testing procedure on diffusing glassware is to assist the manufacturer in appraising the uniformity in glass thickness and diffusion. By reference to weights and total output and the following detailed luminance observations, one can estimate diffusing properties, and tell whether this product was free of thin spots, improper distribution of opacifying material, etc.

*A**. Grazing luminance in the horizontal plane passing through the light source.

*B**. Same as position *A* of col 1.

*C**. Grazing luminance viewed horizontally at the bottom of the globe.

*D**. Maximum luminance viewed horizontally above the maximum diameter of the globe.

E. Same as position *E* of col 1.

*F**. Grazing luminance viewed vertically.

*G**. Same as position *G* of col 1.

*H**. Luminance viewed vertically halfway between positions *G* and *F*.

I. Luminance viewed horizontally at the point defined as *E*.

J. Luminance viewed vertically at the point defined as *E*.

*K**. Luminance at a point midway between *A* and *B*, in the horizontal plane through the light source, viewed in a direction parallel to *B*. The line of sight

Luminance Readings on All Filament Type Luminaires (see *Fig.* 1)
(1)

Luminance Measurements on Diffusing Enclosing Globes (see *Fig.* 1)
(2)

will make an angle of 45° with the normal to the surface of the globe.

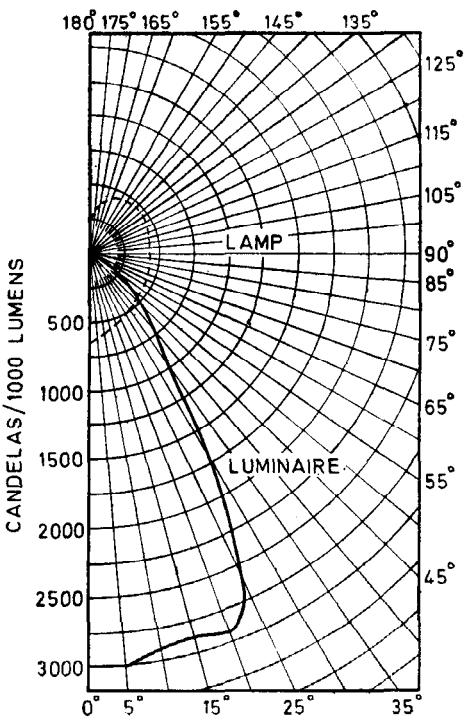
L. Maximum luminance below maximum diameter viewed at 75° from the nadir.

M. Maximum luminance above maximum diameter viewed at 75° from the nadir.

N. Maximum luminance above maximum diameter viewed at 80° from the nadir.

NOTE 1 — The letter designation indicates the position of luminance readings/measurements as given in Fig. 1.

NOTE 2 — The letter designation followed by an asterisk indicates a reading to be made with the globe rotating, which reading will be the average of the luminance at all orientations.



Luminance Measurement	
Angles*	Cd/cm²
85°	20
75°	850
65°	680
55°	990
45°	2 600

*Luminance measurements may also be taken at 30° and 0°.

FIG. 2 TYPICAL PHOTOMETRIC TEST REPORT

*All mogul base type.

INDIAN STANDARDS

ON

ILLUMINATING ENGINEERING

IS:

1777-1961 Industrial lighting fittings with metal reflectors
1885 (Part XVI/Sec 1)-1968 Electrotechnical vocabulary: Part XVI Lighting, Section 1 General aspects
1885 (Part XVI/Sec 2)-1968 Electrotechnical vocabulary: Part XVI Lighting, Section 2 General illumination, lighting fittings and lighting for traffic and signalling
1913-1969 General and safety requirements for electric lighting fittings (*first revision*)
1944-1970 Code of practice for lighting of public thoroughfares
1947-1961 Flood lights
2149-1970 Luminaires for street lighting (*first revision*)
2206 (Part I)-1962 Flameproof electric lighting fittings: Part I Well-glass and bulkhead types
2493-1963 Well-glass lighting fittings for use underground in mines (non-flameproof type)
2672-1966 Code of practice for library lighting
3287-1965 Industrial lighting fittings with plastic reflectors
3528-1966 Waterproof electric lighting fittings
3553-1966 Watertight electric lighting fittings
3646 (Part I)-1966 Code of practice for interior illumination: Part I Principles for good lighting and aspects of design
3646 (Part II)-1966 Code of practice for interior illumination: Part II Schedule for values of illumination and glare index
3646 (Part III)-1968 Code of practice for interior illumination: Part III Calculation of coefficients of utilization by the BZ method
4012-1967 Dust-proof electric lighting fittings
4013-1967 Dust-tight electric lighting fittings
4347-1967 Code of practice for hospital lighting
5077-1969 Decorating lighting outfits
6585-1972 Screwless terminal and electrical connections for lighting fittings
6665-1972 Code of practice for industrial lighting
7537-1974 Road traffic signals

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